

Information and Assessment Needs for Permitting and Management

Russell Levens

Hydrogeologist

DNRC Water Management Bureau

Outline

- I. Overview of Permitting
- II. Surface water depletion / augmentation
- III. Information and assessment needs for permitting
- IV. Information and assessment needs for management

Basin Closures

COMPACT CLOSURES

Chippewa Cree Tribe of the Rocky Boy's Reservation-Montana Compact Effective 12/9/1999 (932 sq. mi.)
-Big Sandy Creek (Excluding Sage Creek and Lonesome Lake Coulee) and Beaver Creek (40H)

Crow Reservation-Montana Compact Effective 6/16/1999 (3,586 sq. mi.)
-Bighorn River(43P), Little Bighorn River(43O), Pryor Creek(43E), Rosebud Creek within the Reservation(42A), and these drainages within the Reservation: Youngs Creek, Squirrel Creek, Tanner Creek, Dry Creek, Spring Creek(42B), Sarpy Creek(42KJ), Cottonwood Creek, Five Mile Creek, Bluewater Creek(43D), Sage Creek(43N), Fly Creek, Blue Creek Dry Creek and Bitter Creek(43Q)

Fort Belknap Reservation-Montana Compact Effective 4/6/2001 (15,071 sq. mi.)
-Milk River Basin, both above the Western Crossing and below the Eastern Crossing of boundary between U.S. and Canada (40GF, 40G, 40H, 40I, 40J, 40K, 40L, 40M, 40N, and 40O). Supercedes pre-existing closures.

National Park Service-Montana Compact Effective 1/31/1994
-Big Hole Battlefield (41D)
-Glacier N.P. (76LJ, 76I, 40T, 41L & 41M), (1,580 sq. mi.)
-Yellowstone N.P. (43B, 41F & 41H), (1,820 sq. mi., 251 sq. mi. within Montana)
-Little Bighorn Battlefield Nat. Monument (43O)
-Bighorn Canyon (43P)

Northern Cheyenne-Montana Compact Effective 5/17/1991 (1,307 sq. mi.)
-Rosebud Creek Basin Moratorium (42A)

United States Fish and Wildlife Service-Montana Compact Effective 5/7/1991
-Benton Lake (249 sq. mi.) and Black Coulee (136 sq. mi.)
-National Wildlife Refuges (41O)
Effective 4/19/1999 (239 sq. mi.)
-Red Rock Lakes National Wildlife Refuge (41A)

CONTROLLED GROUNDWATER AREAS

Bozeman Solvent Site (41H)
Effective 7/20/98 (approx. 5.5 sq. mi.)

Hayes Creek (76HB)
Permanent Closure 5/25/95 (0.08 sq. mi.)
Permanent Closure 12/1/99 (3.9 sq. mi.)

Idaho Pole Site (41H)
Effective 12/30/01 (0.1 sq. mi.)

Larson Creek (76HF)
Effective 11/14/98 (6 sq. mi.)

Old Butte Landfill/Clark Tailings Site (76G)
Effective 12/17/99 (1.2 sq. mi.)

Paradise Railway (76N)
Effective 08/19/02 (0.5 sq. mi.)

Powder River Basin (42A, 42B, 42C, 42I, 42J, 42KJ, 43O, 43P)
Effective 12/15/99 (7,105 sq. mi.)

Rocker (76G)
Effective 5/30/97 (26 sq. mi.)

South Pine (42L & 42M)
Effective 11/1/97 (178 sq. mi.)

Sykes Canyon (41H)
Effective 04/26/2002 (4.75 sq. mi.)

Warm Springs Ponds (76G)
Effective 5/25/95 (6 sq. mi.)

Yellowstone Controlled Groundwater Area
U.S.N.P.S.-Montana Compact (41F, 41H, 43B)
Effective 1/31/94 (1,334 sq. mi.)

LEGISLATIVE CLOSURES

Bitterroot Basin Temporary Closure (76H)
Effective 3/29/99 (2,862 sq. mi.)

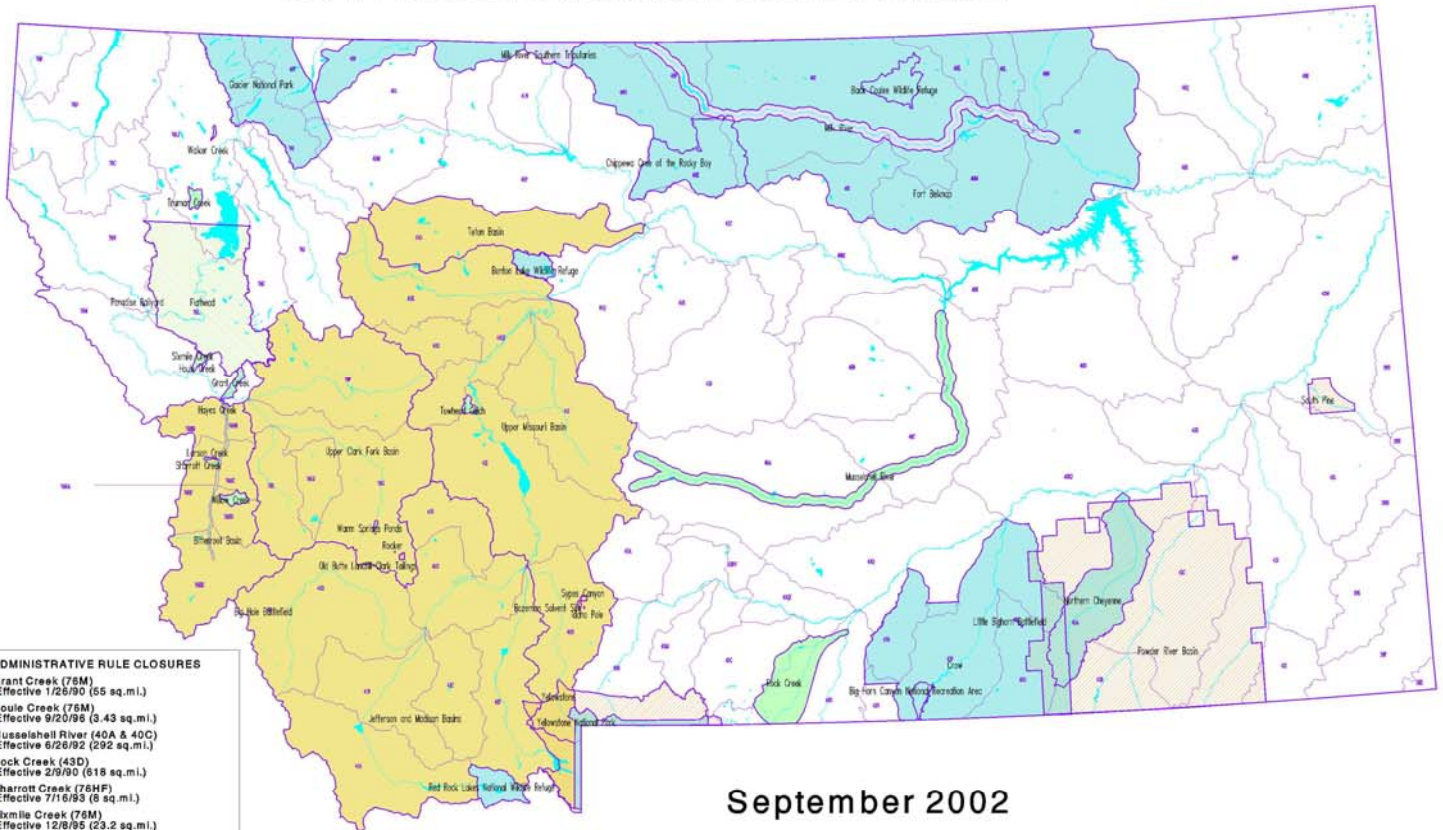
Jefferson and Madison Basins
(41A, 41B, 41C, 41D, 41E, 41F, & 41G)
Effective 4/1/93 (11,660 sq. mi.)

Teton Basin (41O)
Effective 4/21/93 (1,917 sq. mi.)

Upper Clark Fork Basin (76E, 76F, 76G, 76GJ)
Effective 4/1/95 (6,017 sq. mi.)

Upper Missouri Basin (41H, 41I, 41J, 41K, 41QJ, 41U)

MONTANA SURFACE WATER CLOSURE AND CONTROLLED GROUNDWATER AREAS



ADMINISTRATIVE RULE CLOSURES

Grant Creek (76M)
Effective 1/26/90 (55 sq. mi.)

Houle Creek (76M)
Effective 9/20/96 (3.43 sq. mi.)

Musselshell River (40A & 40C)
Effective 6/26/92 (292 sq. mi.)

Rock Creek (43D)
Effective 2/9/90 (618 sq. mi.)

Sharrott Creek (76HF)
Effective 7/16/93 (6 sq. mi.)

Stikmile Creek (76M)
Effective 12/8/95 (23.2 sq. mi.)

Towhead Gulch (41I)
Effective 1/17/92 (7 sq. mi.)

Truman Creek (76LJ)
Effective 2/10/95 (7 sq. mi.)

Walker Creek (76LJ)
Effective 9/28/90 (40 sq. mi.)

Willow Creek (76HD)
Effective 9/23/94 (61.4 sq. mi.)

DEPARTMENT ORDERED MILK RIVER CLOSURES

Milk River Basin Mainstem (40F, 40J, 40O)
Effective 1/1/83 (283 sq. mi.)

Milk River Southern Tributaries (40F)
Effective 9/1/91 (152 sq. mi.)

September 2002

MONTANA SUPREME COURT ORDER

Flathead Indian Reservation Closure (2,081 sq. mi.)
Effective until the Confederated Salish and Kootenai tribes' water rights are quantified or otherwise resolved.



Zedler path: \npas\pds\basin\basin\2002\2002.mxd

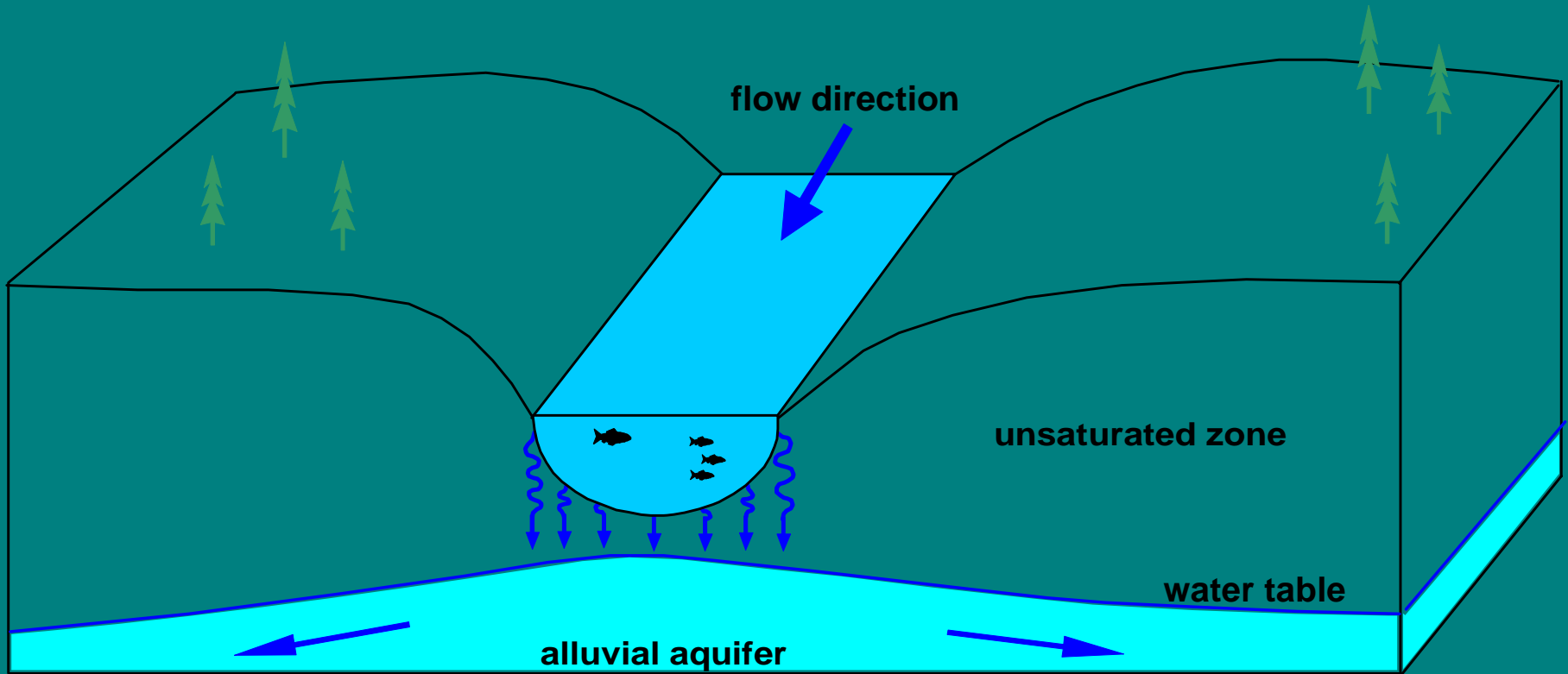
I. Permitting

- Physical water availability at the point of diversion
- Legal water availability within the area of potential impact
- Potential for adverse effects to wells and surface waters considering an applicant's plan to control their usage

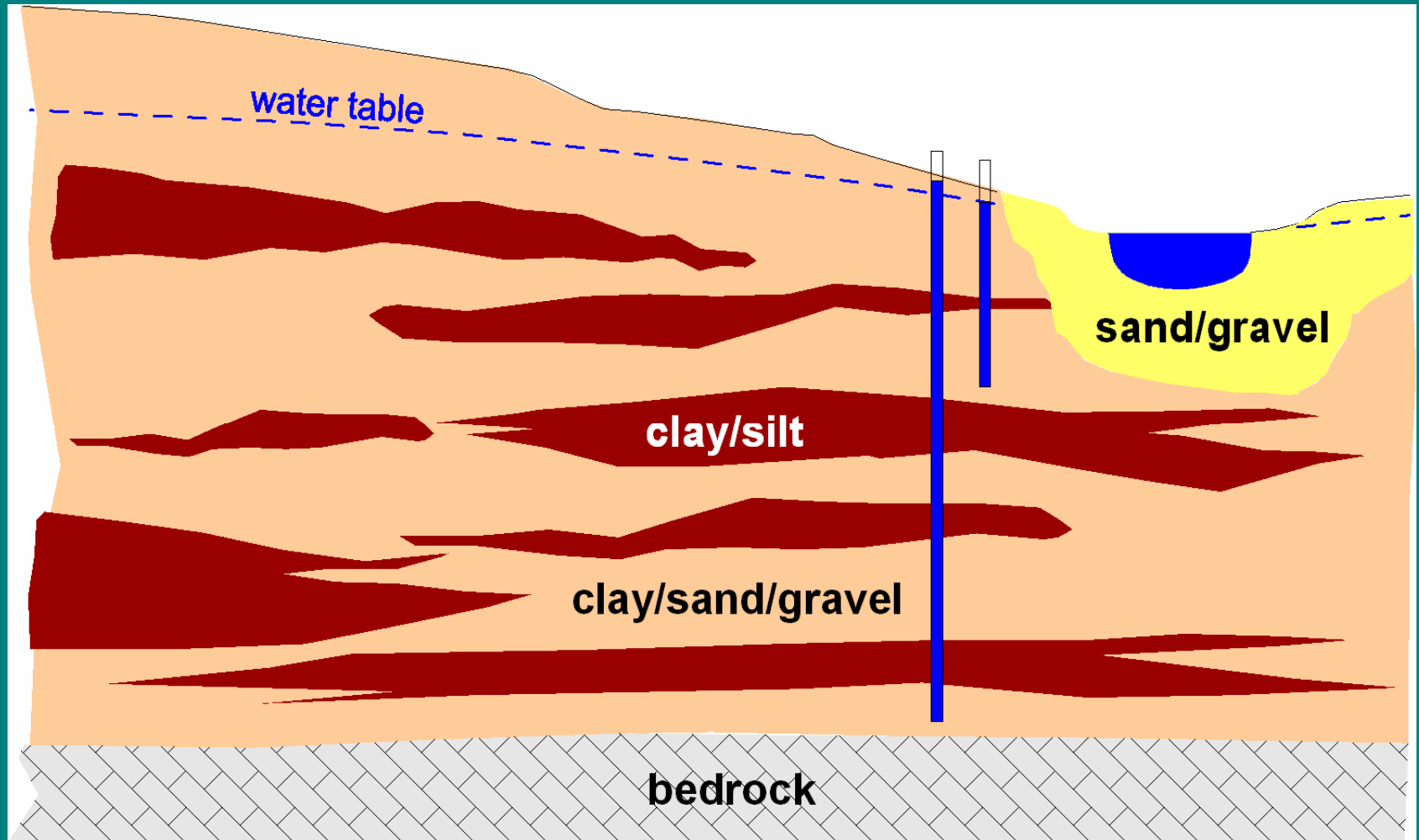
II. Surface Water Depletion / Augmentation

- Hydraulic connection
 - saturation
 - continuity and properties of “confining layers”
 - matter of degree
- Modeling depletion or augmentation
 - rate and timing
 - location

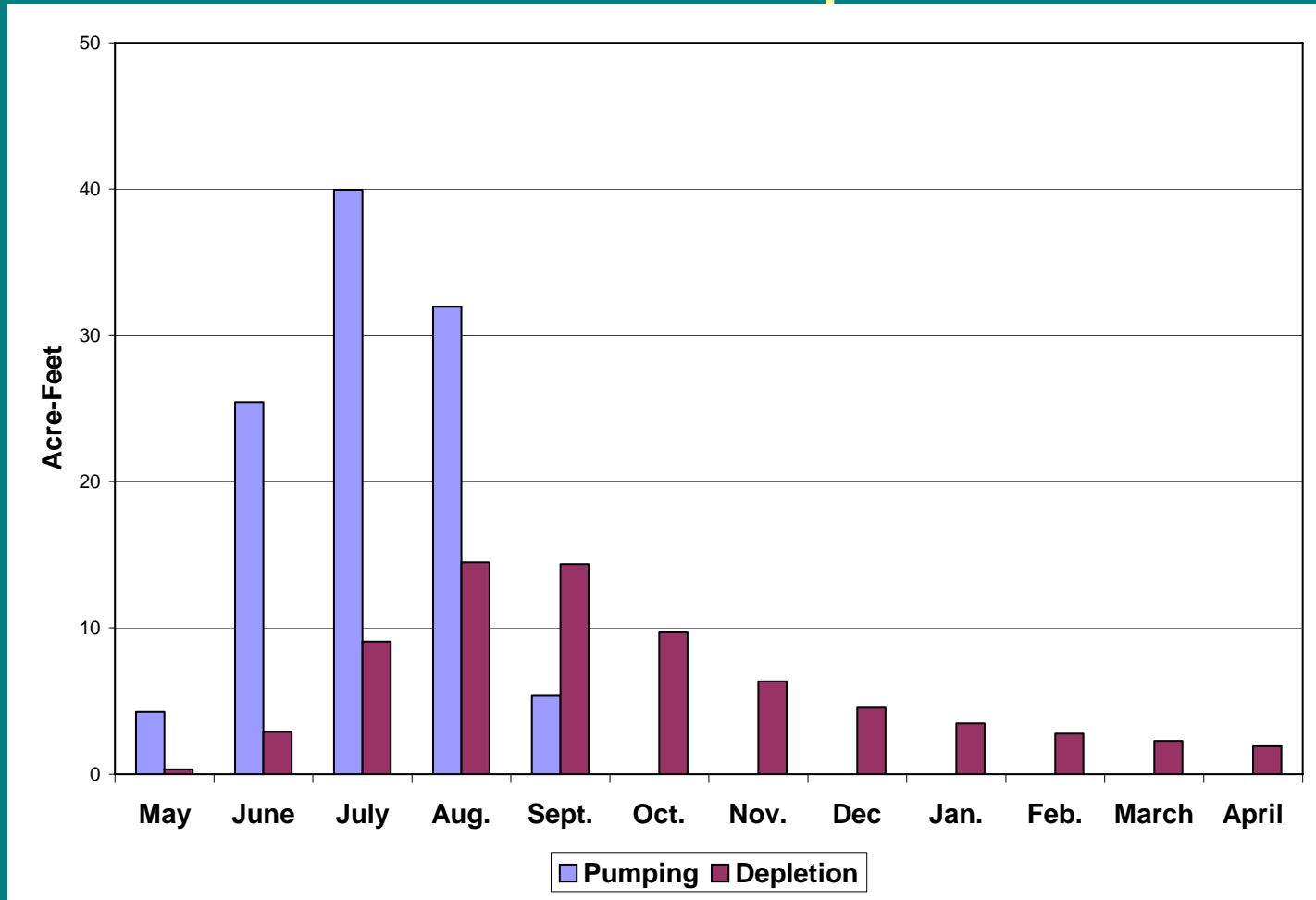
Hydraulic Connection - Perched Stream



Hydraulic Connection – Discontinuous Strata



Rate and Timing of the Effects of Stream Depletion



Depends on: pumping rate, return flows, distance, aquifer and streambed properties, and aquifer boundaries

Location of the Effects of Depletion or Augmentation



Challenges for Augmentation

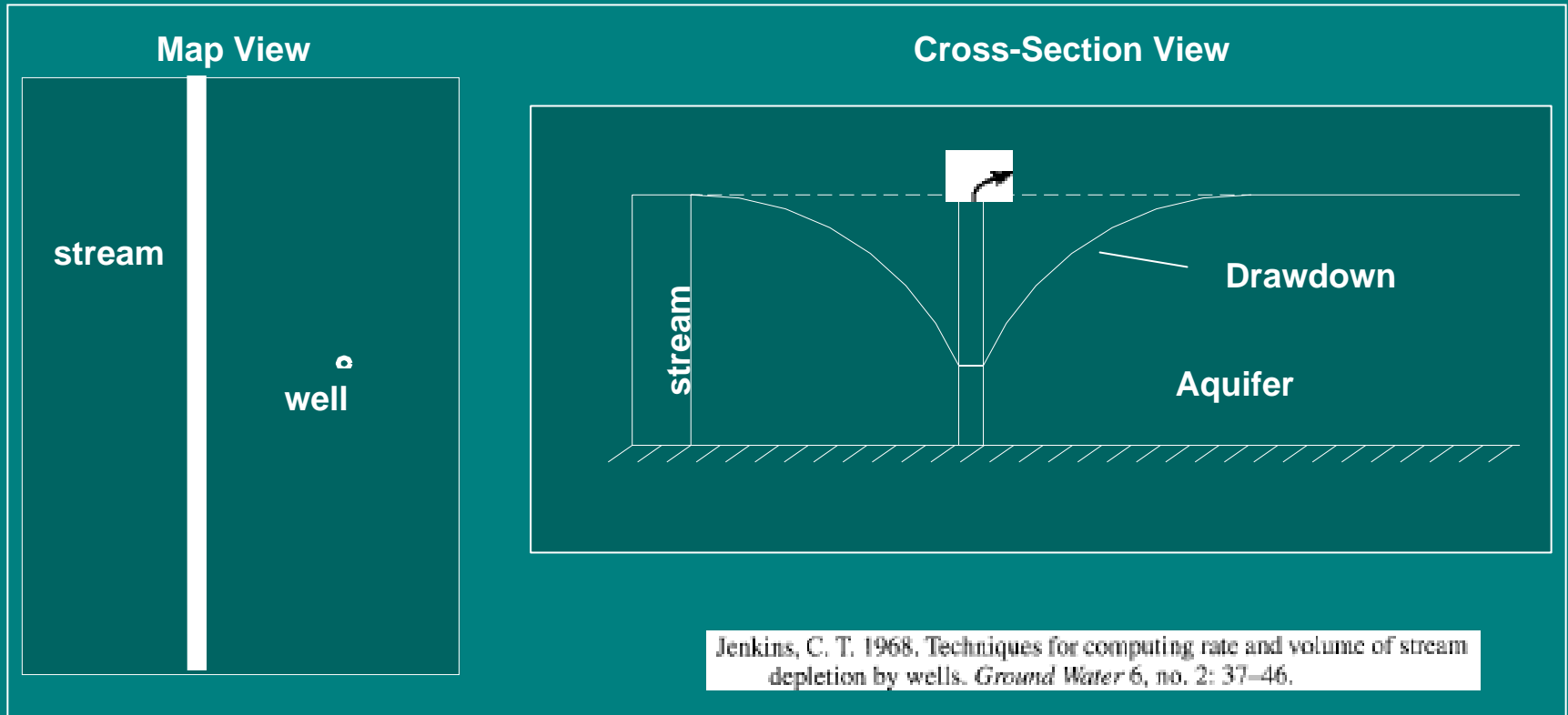
- retiring a seasonal water right to mitigate year-round use
- mitigating residual depletion
- mitigating depletion of multiple sources
- monitoring effectiveness

III. Information and Assessment Needs for Permitting

Stream Depletion / Augmentation Modeling

- Simple analytical models
- Uncalibrated numerical models
- Calibrated numerical models

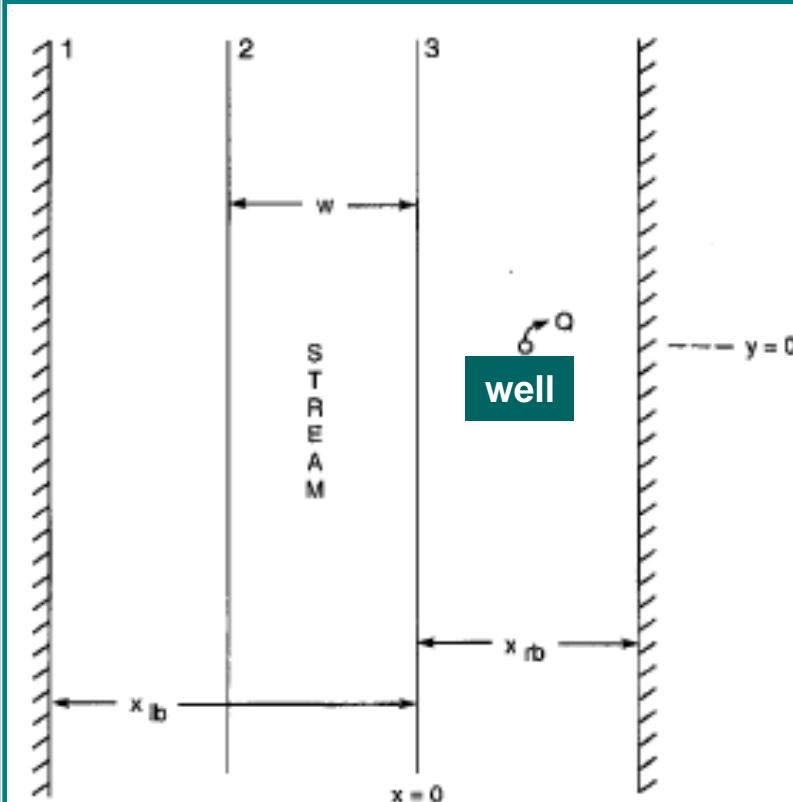
Jenkins Method



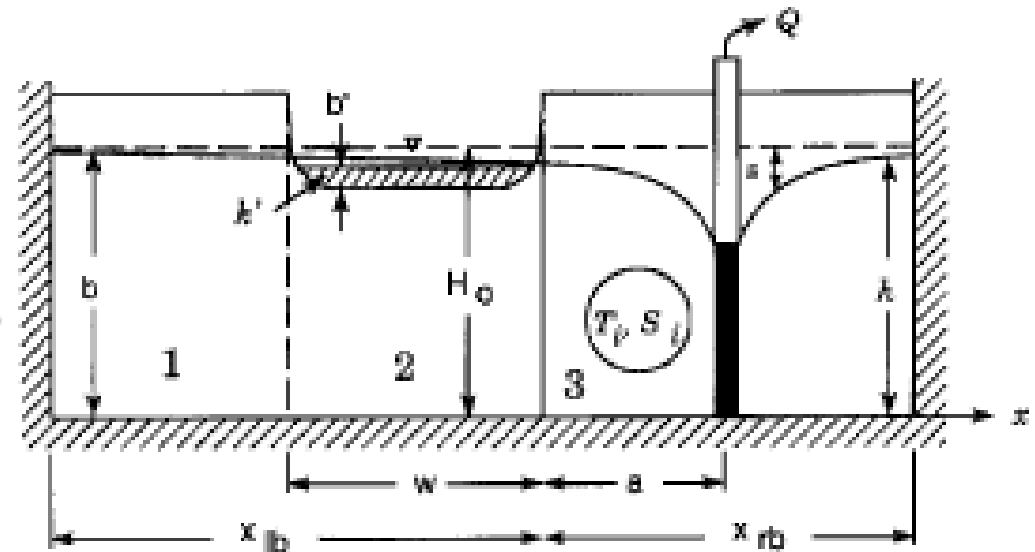
Need: T , S_y , distance to stream

Partially Penetrating Stream with Parallel No-Flow Boundaries

Map View



Cross-Section View



Butler, J.J., V.A. Zlotnik, and M.S. Tsou, 2001. Drawdown and stream depletion produced by pumping in the vicinity of a partially penetrating stream. *Ground Water* 39, no. 5: 651-659.

Need: T , S_y , k' , b' , distance to stream, distances to boundaries

Numerical Models



Stream Depletion / Augmentation Modeling

- Analytical models
 - simple and consistent
 - input data are readily obtainable
 - do not represent complex conditions
- Numerical models
 - detailed
 - can be used to represent complex conditions
 - require extensive supporting data
 - subjective

Information for Permitting

- Hydraulic connection
 - geology
 - ground-water levels
 - stream flows
- Rate, timing, and location of depletion
 - aquifer and streambed properties
 - consumptive use
- Prior appropriators
 - locations
 - requirements
- Augmentation verification
 - ground-water levels
 - stream flows

IV. Information and Assessment Basin-wide Management

All of the above +

- Dynamic water budget
- Numerical modeling to assess basin-wide effects of withdrawals and augmentation
- Monitoring to assess the effectiveness of augmentation

Items for Discussion

- How should hydraulic connection be evaluated for permitting?
- What tools should be used to assess stream depletion and design augmentation plans for permitting?
- Can augmentation plans be monitored or otherwise verified?
- Should basin-wide numerical models be used for making ground-water management decisions?
- Novel augmentation approaches?